EGU22-8339
https://doi.org/10.5194/egusphere-egu22-8339
EGU General Assembly 2022

How was the Bushveld Complex assembled? A search for cryptic layering in ICDP drillcores from the Main Zone

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The Main Zone of the Bushveld Complex in South Africa is the most voluminous but least studied part of the world's largest igneous intrusion. Modal layering is poorly developed compared with the units above and below (Upper and Critical Zones, resp.), and most of the ca. 3000 meter-thick Main Zone consists of monotonous gabbronorite, occasionally grading into norite and anorthosite. An exception is the ultramafic "Pyroxenite Marker" near the top of the Main Zone, which is present regionally in the complex and represents a major event of magma recharge into the chamber. However, studies of drillcore through the Main Zone in the Bushveld Northern limb (Ashwal et al., 2005; Hayes et al., 2017) found evidence for layering by periodic variations in rock density at vertical length-scales of 40 to 170 m. This implies there were many more episodes of magma recharge than previously thought.

Our study in the Eastern Limb of the complex tests if cryptic layering in the Main Zone is a local phenomenon or is regionally developed like the Pyroxenite Marker. The first step, reported here, was a vertical profile of bulk density data (Archimedes method) for a 1450 m section of the upper Main Zone below the Pyroxenite Marker. Samples were taken at 1 to 5 m intervals and the results show several intervals of density variations at length-scales of 30 to 120 m, comparable to those previously described in the Northern Limb. Periodicity in density changes is not so well developed as in the earlier study, and we identified several 50 to 75 m intervals where density variations are below 0.05 g/cm^3. The second step of the study will use multispectral and laser-induced breakdown spectroscopy (LIBS) scanning to provide modal mineralogy profiles of the same drillcore samples used for density measurement. After cryptic modal layering is documented in this way, follow-up petrologic-geochemical studies at the layer boundaries will aim to characterize the composition and temperature of the magmas involved.

For this project the Bushveld Complex Drilling Project (BVDP) provided access to the BH7771 borehole, donated by Impala Platinum's Marula mine.

References:

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